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TESTS ON THE PACKAGING OF GLADIOLUS FOR PROTECTION AGAINST FREEZING

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TESTS ON THE PACKAGING OF GLADIOLUS FOR PROTECTION AGAINST FREEZING

In 1942, the Railway Express Agency, Inc. conducted a test to determine the amount of wrapping required in different types of shipping containers to prevent freezing damage to gladiolus being shipped from Florida to northern points during very cold weather. This test was conducted in a room held at 10°F. for 7-1/2 hours, using different containers and wrappings. As a result of this test, the banana type hamper in which the flowers are wrapped with 1 layer of 40 lb. Kraft and 3 layers of newspaper folded over at each end was accepted as standard.

The subsequent development and use of cardboard cartons as a container for shipping gladiolus raised the question as to how much wrapping is required in this container to afford the same degree of protection as in the standard banana hamper pack. In view of this, the Department was asked by the Florida Gladiolus Growers Association to conduct a series of tests at its Beltsville laboratories to determine the protection afforded by the new type containers with different amounts of wrapping and to compare the results with those obtained in the standard banana hamper pack. Two hundred dozen flowers for the test were furnished by the Association, also the hampers and the cardboard cartons. Representatives of the Railway Express Agency and of the Florida Gladiolus Growers Association assisted in the tests and observed the results.

Test Containers:

The type of containers used in the test with the wrapping used is outlined below:

Package	Container	Wrapping
A	Banana type hamper	Kraft plus 3 layers of newspaper
B	" " "	" " 6 " " "
C	Ventilated cardboard carton	" " 1 layer " "
D	" " "	" " 3 layers " "
E	" " "	" " 6 " " "
F	Unvented cardboard carton	No inner wrapping
G	" " "	Kraft only
H	" " "	" plus 1 layer newspaper
J	" " "	" " 3 layers "
K	" " "	" " 4 " "

In wrapping the flowers, a sheet of Kraft paper was spread out and then newspaper was placed on it so that both extended about a foot beyond each end of the bundle of flower stalks, in order that they could be doubled over the top and bottom of the bundle. The ends thus folded over were fastened by means of Scotch tape as a suitable stapler was not available. All folds were held down satisfactorily by the tape for the duration of the test.

The containers used are shown in figures 1, 2 and 3. Figure 1 is the banana type hamper, 47" high and 19" in diameter at the top. Both types of the cardboard carton, vented and unvented, are shown in Figure 2. Their dimensions were 13" x 13" x 41". The vented carton has short flaps on the top and is used with the ventilated top. The unvented carton has no separate top but the flaps were interfolded to close the top. Figure 3 shows the false waxed bottom and the regular bottom used on both the vented and unvented cartons. Figure 4 shows the regular carton used to ship the test flowers commercially from Florida to Beltsville.

Test Equipment:

The temperature indicating equipment consisted of thermocouple cable sets of copper and constantan wire and a Rubicon potentiometer. For flower temperatures a thermocouple was inserted into a bud as far as possible and then tied in order to prevent it from coming out during the handling of the package (see figure 5). For the air temperature, a thermocouple was fastened in the top of the package to the other wires just over the flower heads as also shown in figure 5. Center and side flower temperatures were taken in buds from 12 to 14 inches below the level of the tips, generally in the lowest bud on the stem. All thermocouple leads were run out through the fold of the wrapping so no extra opening existed in the package. Air temperatures in the room were taken by means of a thermocouple suspended between the test packages at about the height of the tips in the package. The test room was one normally used in frozen food work in which temperatures as low as 15° below zero F. may be obtained. The controls were set for 10°F. above zero for this test.

Test Procedure:

The flowers were cut on Friday, December 10 and shipped on Saturday, December 11 from Ft. Myers, Florida. They arrived at Beltsville, Maryland about noon on Monday. They were of B grade with 36" stems. Each carton contained 20 dozen flowers. Immediately upon arrival at the laboratory, the thermocouples were installed and the test packages prepared. All were held overnight in a 62° room. There were 8 test packages with Picardy variety and one each with Beaton and Beacon. At 9:30 the next morning, the test packages were placed in the 10°F. room. At the first reading one half hour later, the room had warmed to 16.8°F. but by 11:00 A.M. it was down to 9.5°. Due to sluggish controls, the room warmed to about 15° by 3:00 P.M. and then was dropped to 3° at 4:00 P.M. when the controls failed to release. By 7:00 P.M. the room was back up to 10° but further trouble dropped it to 3° by 8:00 P.M. when the test was terminated. These fluctuations resulted in more severe conditions than were planned in attempting to simulate extreme transit hazards. Flower , temperature readings were taken every hour and room air temperatures every half hour. Upon completion of the test the flowers were removed from the test room and held until the next morning at about 65°. They were then unwrapped and placed in water and final inspection made about 4:00 P.M.

Results:

After 10-1/2 hours exposure to temperatures that went as low as 3°F., all of the packages tested showed some freezing damage although it was very slight in one case. This was a very severe test because of the length of the exposure and the low temperatures. The data show that the coldest temperature was nearly always at a side position. This is believed due to the thermocouple being in a flower on the outside of the bunch which was pressed firmly against the wrapping and thus provided a rapid heat flow by reason of this contact. However, in package J, the temperature of flowers at the side were consistently higher than in the top flower due probably to an air space between the wrapping and thermocouple. As would be expected, the top air temperature in the package was lower than the flower temperature except in packages A, B, and D, where apparently the flower was in contact with the wrapping after the top fold was made.

For the purpose of making comparisons between packages, the 3 flower temperatures were averaged and plotted against time in Figures 6, 7 and 8. In most cases, temperatures dropped more slowly with a greater thickness of paper. However, in package E, side temperatures dropped much more rapidly than in package D which had 3 layers less of newspaper. This may have been due to the thermocouple being pressed against the wrapping opposite one of the vent holes in the carton. The same reversal of temperatures was found between packages J and K, where the side flower temperatures in J were higher than in the top flower. It appeared that this thermocouple was not pressing against the wrapping as in all other cases but was protected by an air pocket.

In order to compare containers, the average temperatures of A, D, and J (each having 1 layer of Kraft and 3 layers of newspaper) are plotted in Figure 9. These curves clearly show the value of the cardboard carton (both vented and unvented) in affording protection against cold. From a study of Figures 6, 7 and 8 it appears that one layer of Kraft paper is much more effective than one layer of newspaper. The 3 additional layers of newspaper in B resulted in only a slight improvement over A. Again Figure 7 shows that all thicknesses of newspaper gave about the same protection. Figure 8 presents results obtained in the unvented carton. It shows that 1 and 4 layers of newspaper gave about the same protection, but with J (3 layers) gave a higher temperature than is believed reasonable, for the reason stated above.

A study of individual flower temperatures shows that except for packages A and F, no freezing temperatures occurred in less than 5 hours exposure. In A and F, freezing temperatures were noted after approximately 3-1/2 hours. In the other packages it occurred after 5-1/2 to 10 hours. During this first five hours the average air temperature in the room was 12-1/2°F. As previously pointed out, this low temperature and long exposure probably represents a condition that is more severe than would be encountered in transit. Taking 5 hours as a maximum exposure at an average of 12-1/2°F. the following are the minimum flower temperatures recorded in each package (except A and F):

B	33.5°	G	34.5°
C	32.0°	H	33.5°
D	37.6°	J	44.3°
E	31.4°	K	37.0°

In order to provide for a reasonable factor of safety, the flowers should not drop below 31°, which would make all but A and F packages satisfactory for holding 5 hours. To be on the safe side, therefore, the following could be considered as providing adequate protection with the packages and wrappings tested under these conditions:

Banana hamper with Kraft plus 6 layers of newspaper.
Ventilated carton with Kraft plus 3 layers of newspaper.
Unvented carton with Kraft plus 1 layer of newspaper.

Since these tests were conducted in the laboratory and not under actual transit conditions, and may have been too severe, the writers do not feel justified in attempting to draw conclusions as to safe minimum standard wrappings for conditions met in commercial practice.

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Fig 1
BANANA TYPE HAMPER

Fig 2
UNVENTED AND VENTED CARTONS

Fig 3

UNVENTED CARTON SHOWING FALSE WAXED BOTTOM

Fig 4

COMMERCIAL UNVENTED CARTON

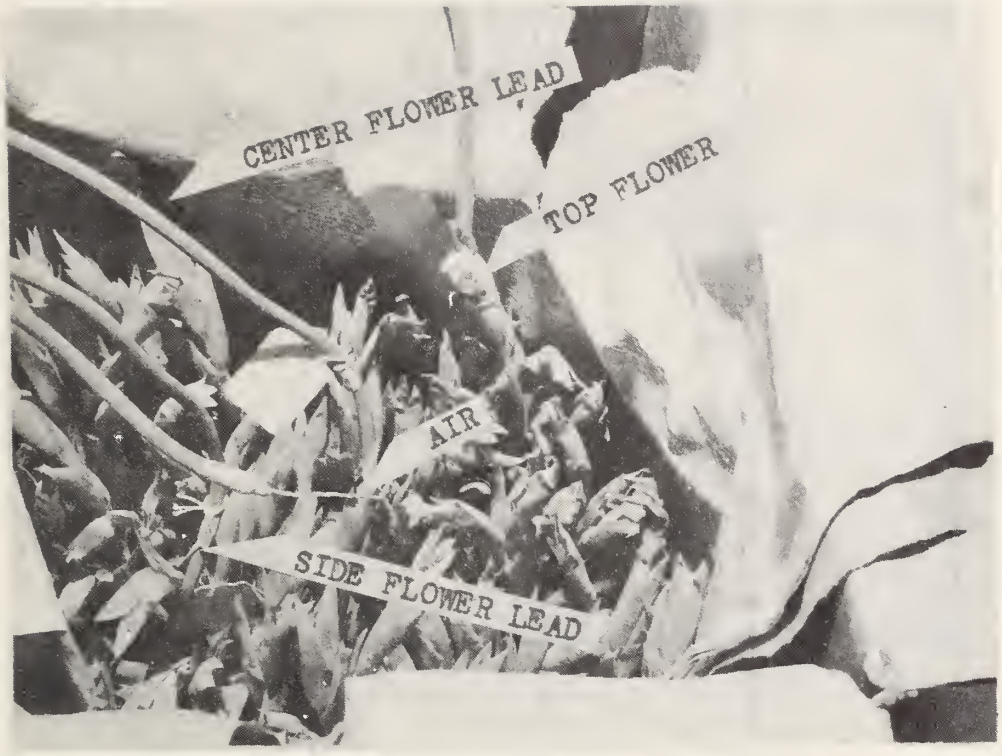


Fig 5

THERMOCOUPLE PLACEMENT

FIG - 6

BANANA TYPE HAMPER
AVERAGE FLOWER TEMPERATURE
A - KRAFT PLUS 3 LAYERS NEWSPAPER
B - " " 6 " "

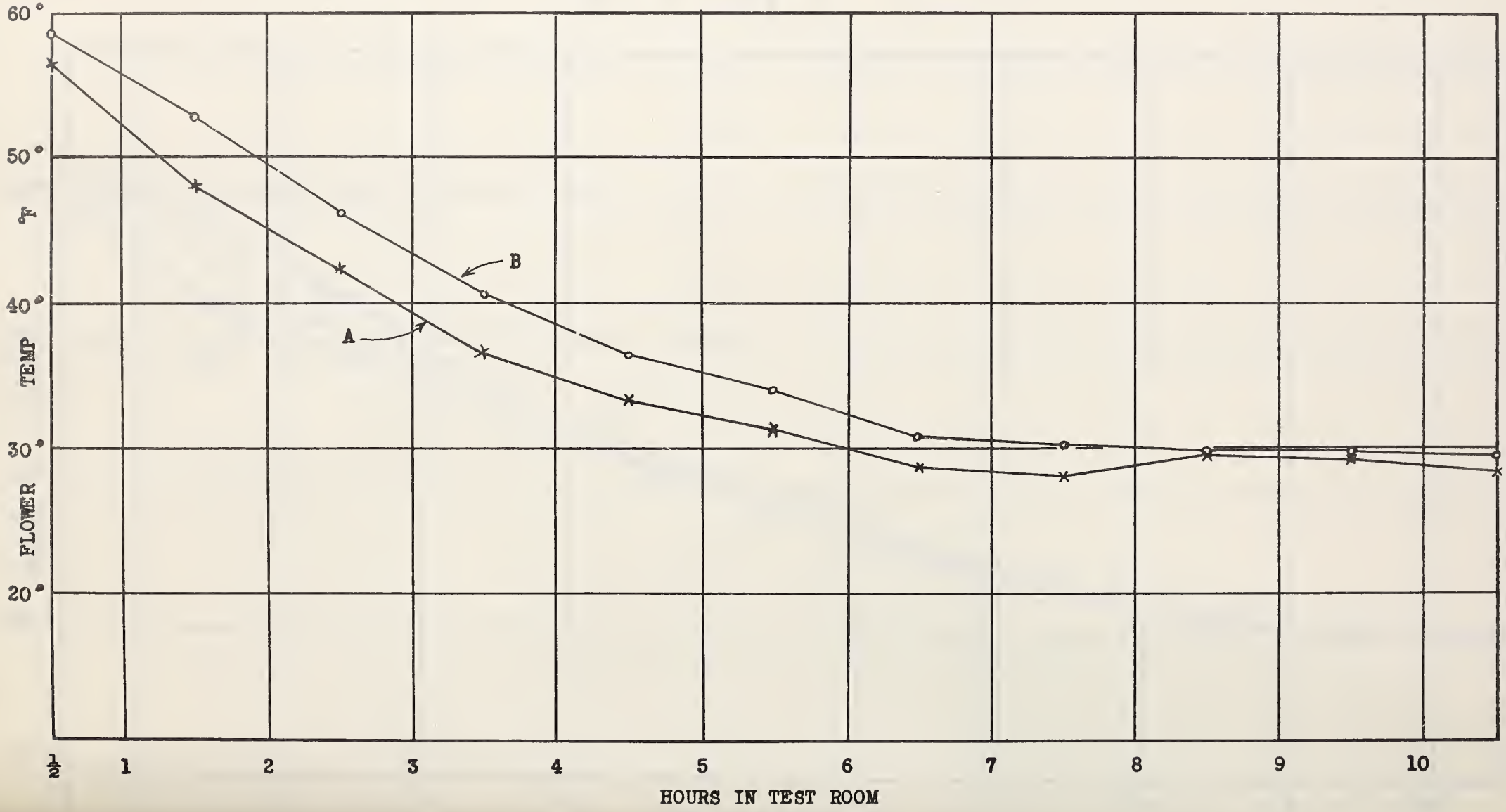


FIG - 7

VENTED CARTON

AVERAGE FLOWER TEMPERATURE

C - KRAFT PLUS 1 LAYER NEWSPAPER
D - " " 3 " "
E " " 6 " "

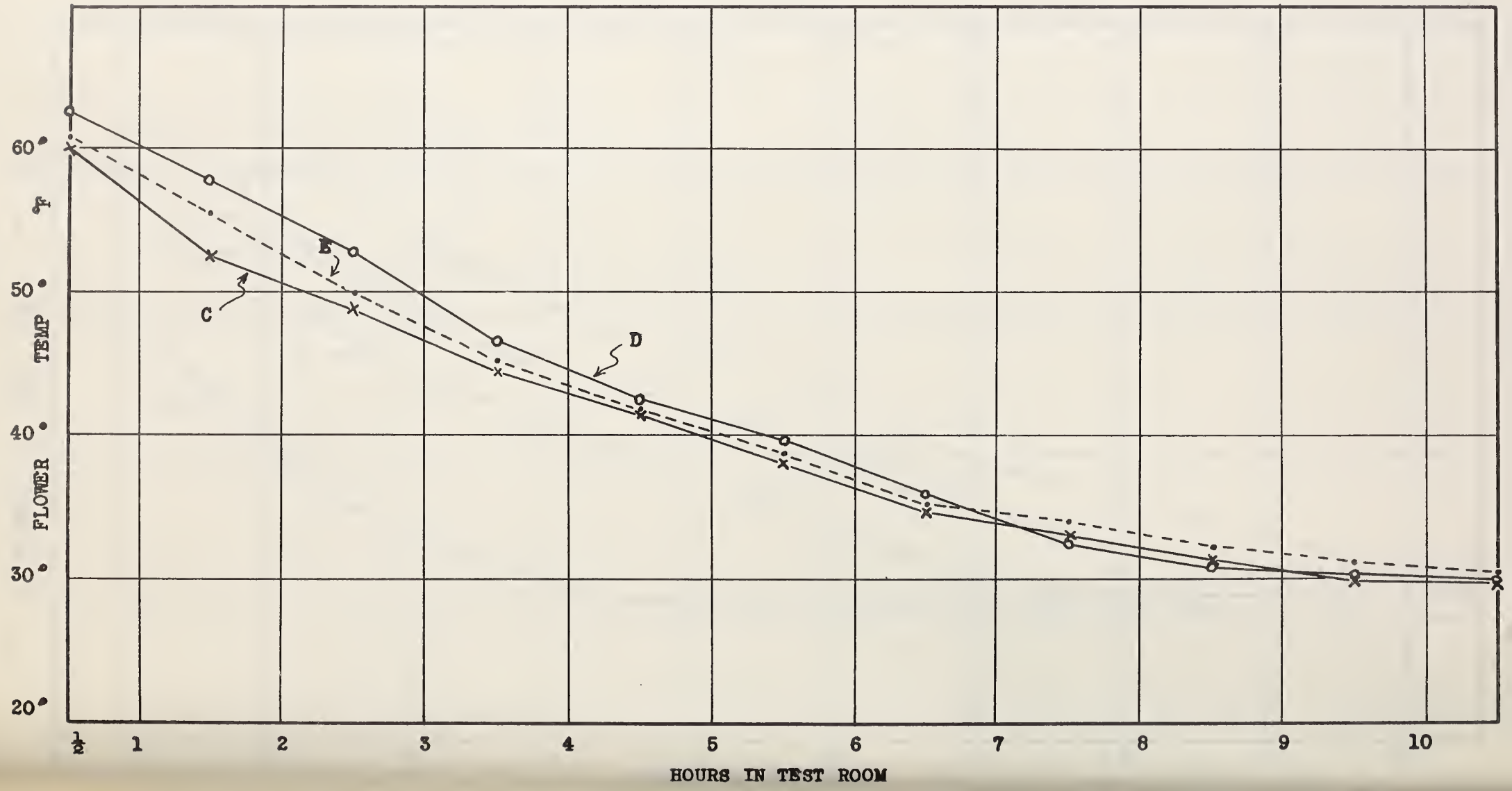


FIG - 8

UNVENTED CARTON

AVERAGE FLOWER TEMPERATURE

F - NO WRAPPING
G - KRAFT ONLY
H - " PLUS 1 LAYER NEWSPAPER
J - " " 3 " "
K - " " 4 " "

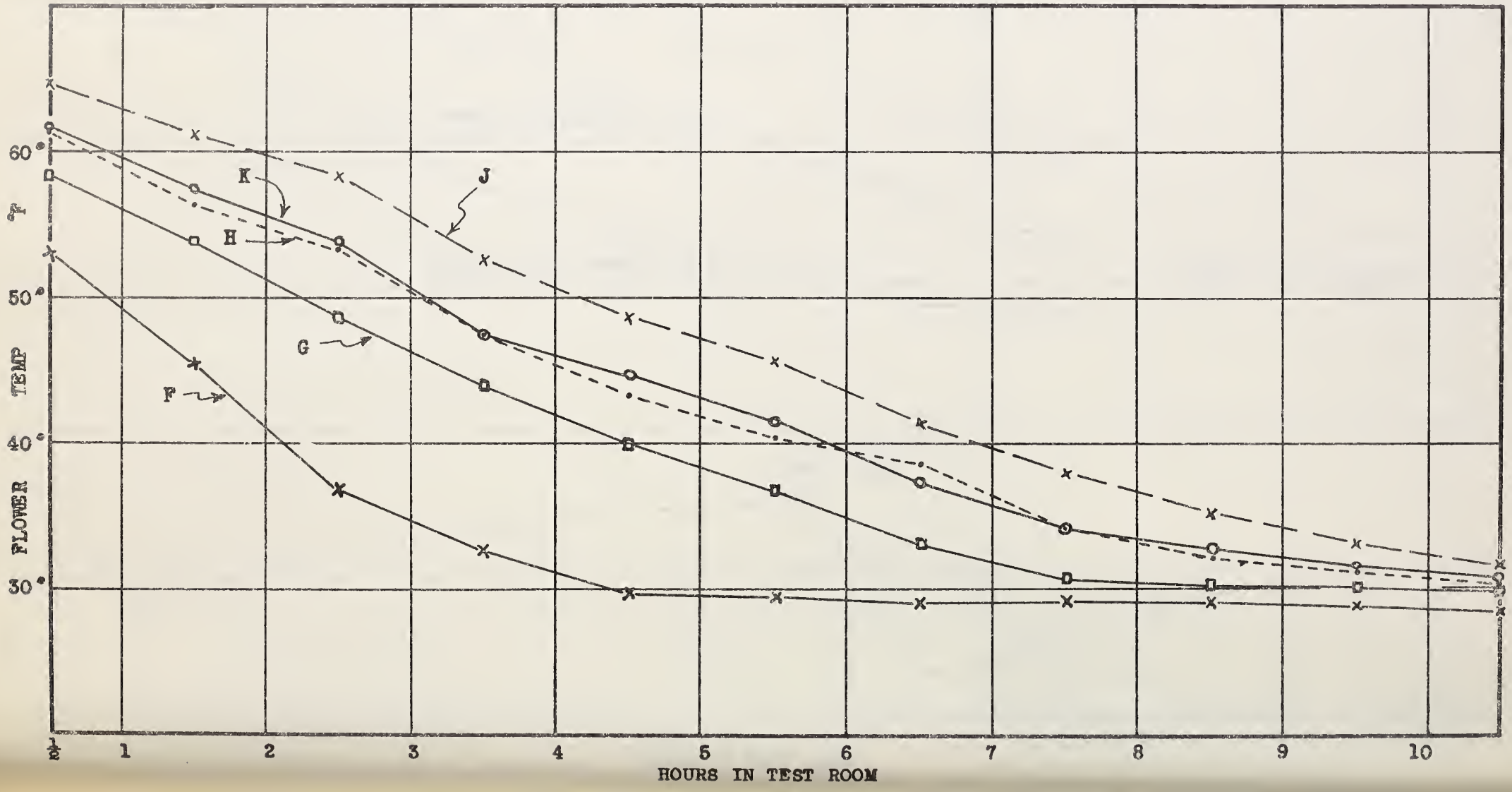
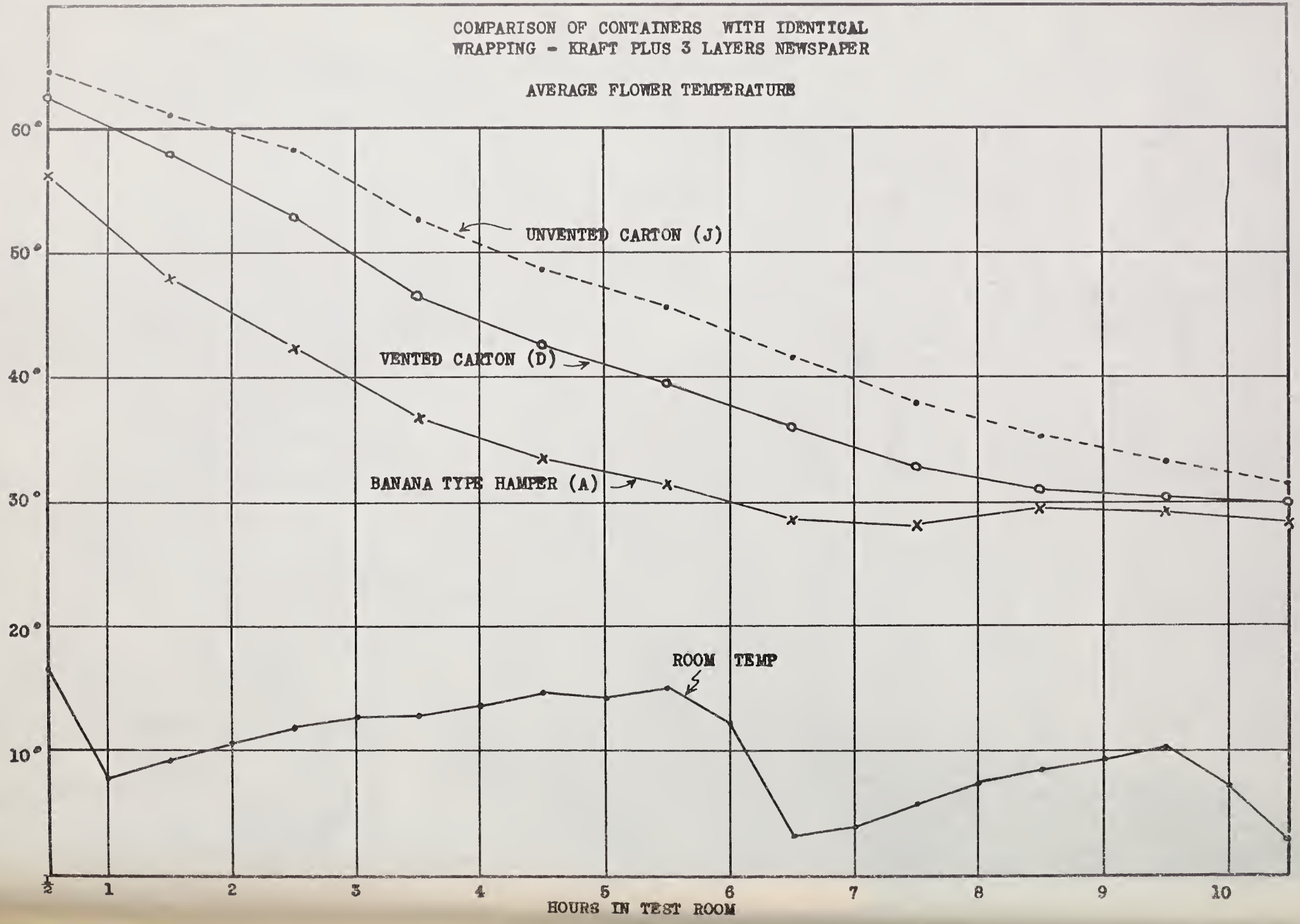


FIG - 9


COMPARISON OF CONTAINERS WITH IDENTICAL WRAPPING - KRAFT PLUS 3 LAYERS NEWSPAPER
AVERAGE FLOWER TEMPERATURE
60°
50°
40°
30°
20°
10°
UNVENTED CARTON (J)
VENTED CARTON (D)
BANANA TYPE HAMPER (A)
ROOM TEMP
½
1
2
3
4
5
6
7
8
9
10
HOURS IN TEST ROOM